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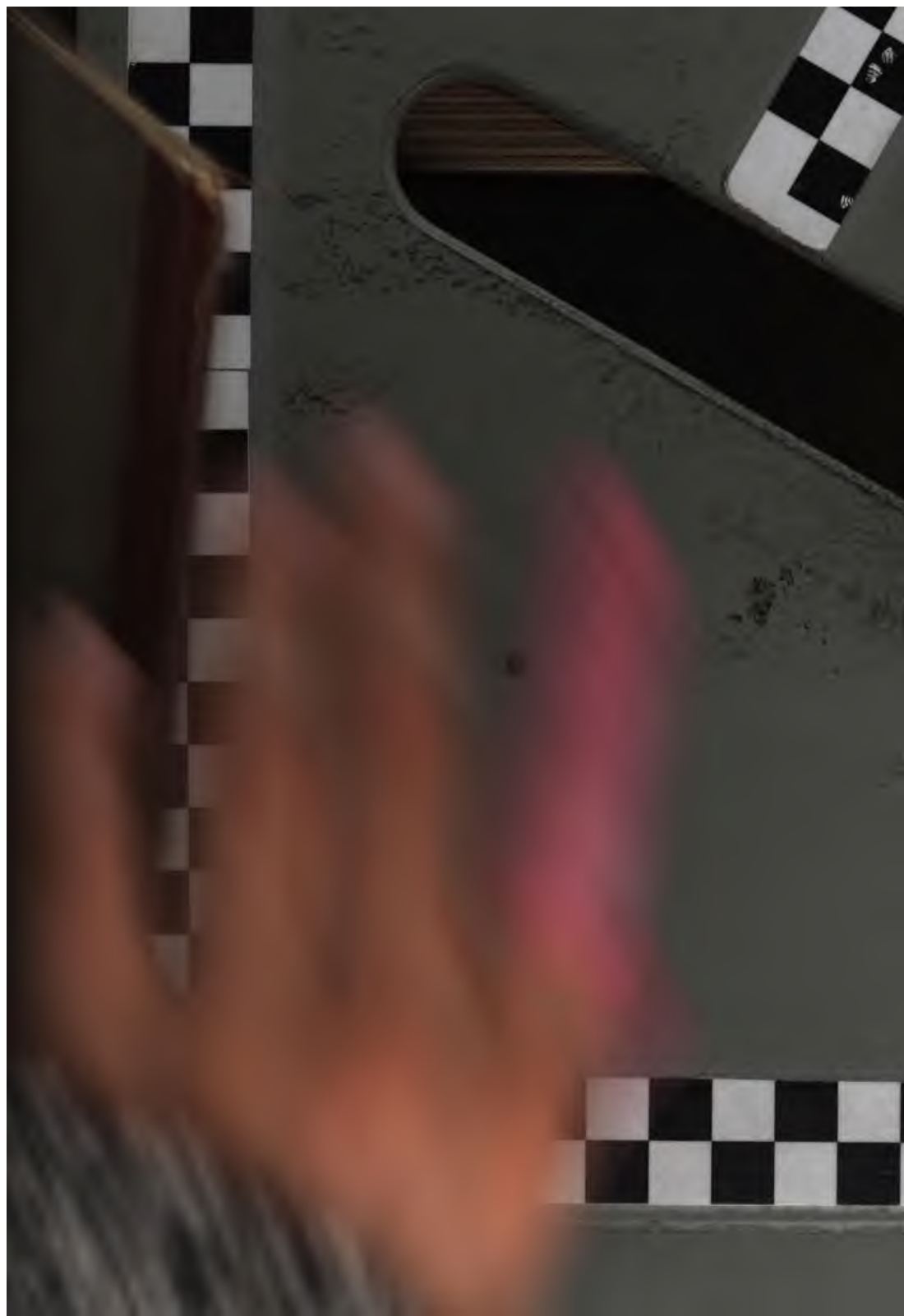
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THE ACOUSTIC PROPERTIES OF ROOMS.

Particularly as Affected by Wall Coverings

by
R. W. CORNELISON, Sc., D.,
Chemist and Superintendent,
Fab-Ri-Ko-Na Mills.

Bloomfield, N. J.
H. B. WIGGIN'S SONS COMPANY.
1905.

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The Acoustic Properties of Rooms.

Particularly as Affected by Wall Coverings.

It would be needless to attempt to explain to the architectural profession the many knotty problems encountered in connection with the acoustic properties of buildings. Even the unprofessional observer is fully aware that great difficulty is sometimes met in overcoming the very disagreeable echo, "whisper," "ring," "empty," or "hollow sound" which are frequently heard in large buildings.

The subject of acoustic properties of public buildings has received a great deal of attention from the architectural profession for many years past. To the architect it is not the indefinite, uncertain, and altogether misty problem that it would seem to the layman. A great deal of study has been expended upon the subject, and this has not been done without obtaining some definite and tangible results. A number of fundamental principles have been established; and, observing these, the architect can in almost all cases avoid the more serious difficulties which might arise.

In considering the subject it will be necessary to take up several different classes of rooms because the phenomena presented and the objects to be attained differ considerably according to the size of and purpose for which the room is to be used. We shall first take up the public hall, auditorium or lecture room.

The range of the voice of the average speaker may be placed at, say, about seventy or eighty feet immediately in front of him. At this distance every syllable can be easily heard. At either side the distance will be considerably less, so that if we place the speaker about twenty feet inside the circumference of a circle of a diameter of, say, ninety feet, we shall probably be able to hear any place within that circle. In other words, the speaker's voice will probably penetrate about twenty feet in the rear, about seventy feet directly in front, and some thirty or thirty-five feet on either side. Of course,

these dimensions must not be taken as perfectly accurate. They are given only as a rough estimate, and with the understanding that the sound is not restricted or reflected by any artificial means.

A great many experiments have been made with the object of increasing the range of the voice of the public speaker. Some of these have been quite successful. Others have been failures; but not necessarily because they did not accomplish the purpose desired. In some cases they failed because they introduced other disagreeable features which more than counterbalanced the benefits derived. Many experiments with parabolic reflectors have been made, sometimes with very marked results. A wooden reflector of some ten feet in diameter is quite efficient. Of course, the reflector is placed back of the speaker, with its focus at his mouth. The voice of the speaker will then be thrown forward, parallel with the axis of the curve. The results attained have been quite remarkable, but unfortunately the effect is not always pleasing to the audience, and in many cases has been very annoying to the speaker. This is because such an instrument works in both ways and, naturally, waves of sound reaching it from the room in front are reflected to the focus, and thereby concentrated about the speaker's head. The audience immediately in front of him, even at a very great distance, would hear him clearly, but those off at one side would not be benefited; and the speaker himself would hear every sound that was made in the room, and that, too, intensified manyfold.

Since sound spreads out in all directions from its source, it is well to utilize that portion of it which goes upward and backward from the speaker. For this reason there should be a wall back of him, and the ceiling over his head should not be too high. In music rooms it is a common thing to have a sounding board over the performer, placed at such an angle as will cause it to throw the sound which passes upward from the performer out to the audience, instead of allowing it to be lost in the large space above. It is well, if not conflicting with other plans, to make the ceiling in a room used for speaking not too high, especially over the speaker. It is also desirable to make the room oblong so that the audience may be seated, as much as possible, in front of the speaker. If this be done, the walls of the room will act in a measure like the sides of a speaking tube.

If sound strike a smooth surface, and if the incident angle made with that surface is very small, the surface will act in a manner similar to a conductor of sound, rather than simply as a reflector. It is often found, we believe, that persons near the wall in an elongated lecture room can hear better than persons nearer the speaker, but in the middle of the room, and perhaps more directly in front of him.

We have been speaking of the influence of form on the transference

of sound from speaker to audience. There is one consideration of which we must not lose sight, the echo. The sound of the speaker's voice may be reflected from the end of the room opposite him in such a manner as to become very annoying. Bearing in mind the rate at which sound travels, the number of syllables one speaks per second, and measuring the distance from the speaker to the wall in front of him, one can compute the amount which the echo will lag behind the voice of the speaker. If the echo is very marked, it will bring back each syllable, and will cause considerable confusion of sound.

We have not spoken of the distribution of the audience, but we might say in passing that in all cases where possible it is advisable to have the benches in steps one above another as we go away from the speaker—that is, in the form of an amphitheater. It is further desirable to arrange them so that a line drawn through the centers of the seats shall be a curve, concave upwards. This curve may be so formed that it will give a certain pyramid of sound, if we may use that term, to each member of the audience. Perhaps it would be more accurate to say a certain pyramid of space for the uninterrupted movement of sound to each hearer. By suitable arrangement of the elevations of the various steps, and the distances apart of the chairs, the audience may be so distributed that these pyramidal spaces will be equal.

We have seen that one of the most serious troubles in an auditorium arises from echoes—that is, the reflection of the sound. A great many methods have been proposed for preventing such echoes. One favorite method has been the stretching of wires through the room. So far as the writer has been able to ascertain there has never been any benefit derived from the use of these wires, nor any theoretical or scientific ground which would justify one in supposing that any benefit might be derived from this expedient. It is safe to say that any experiments in that direction will result simply in waste of time.

In modern buildings it is quite customary to use very hard, smooth plaster, and therefore there is apt to be not only considerable echo, but also considerable resonance. Especially is this true of improved buildings of fire proof construction. This echo or resonance may be checked to some extent by carpeting the floor. It may be checked also by hanging heavy draperies at the windows and doors, or by covering the walls with a loose fabric. Very often, however, it is not desirable to have either carpets or drapery, and a loose fabric on the wall is unsanitary and in no way desirable. Besides, such treatment would be entirely inadmissible in a fire proof building. Wall paper has very little effect, but a Fab-Ri-Ko-Na Burlap will be found to considerably moderate an echo or resonance without completely deadening the sound, and making the room

as disagreeable on account of being too "dead" as it was in the first place on account of too much resonance or echo.

If the room is a lecture room and the speaker is located near the wall, and if it is desirable to gain the very best results, it would be better to have a smooth, hard surface on the wall back of him, because here it is desirable to reflect the sound, but the contrary is true of the wall which the speaker faces. It is not desirable to have any echo or reflection from it.

As an example of the effect of Fab-Ri-Ko-Na Burlap when pasted to the wall of a large auditorium, we would refer to the court house in Wausau, Wisconsin. The echo in the main hall in this court house was such that the room could not be used by the court with any degree of comfort. It was extremely disagreeable, and something had to be done. A local decorator, Mr. H. L. Mumm, suggested covering the walls with Fab-Ri-Ko-Na Burlap, and this was done. The burlap was pasted to the wall as usual. The result was all that could be desired. The room was not so dead as to be disagreeable, and yet all objectionable echoes and resonance were removed. The following letters speak for themselves:

REGULAR TERMS:

SECOND MONDAY IN FEBRUARY
SECOND MONDAY IN SEPTEMBER

CIRCUIT JUDGE:

HON. W. O. SILVERTHORN

OFFICE OF

A. A. BOCK

CLERK OF THE CIRCUIT COURT

MARATHON COUNTY

WAUSAU, WISCONSIN.

Dec. 5th. 1904.

To whom it may concern:-

During 1903 Mr. H. L. Mumm of this city applied burlap etc. to the ceiling and walls of the "Court Room" in the Marathon County Court House in this city, since which, the acoustic properties of said court room are of the best. "A decided improvement".

W. A. Bock
Clerk Circuit Court.

REGULAR TERMS:
SECOND MONDAY IN FEBRUARY
SECOND MONDAY IN SEPTEMBER

CIRCUIT JUDGE:
HON. W. C. SILVERTHORN

OFFICE OF
A. A. BOCK
CLERK OF THE CIRCUIT COURT
MARATHON COUNTY

WAUSAU, WISCONSIN, DEC. 5TH, 1904.

H. L. MATH Esq.

Wausau, Wis.

Dear Sir:-

Your decorating the walls and ceiling of the Court Room with "burlap", has not only added to the appearance of the room, but, greatly benefitted the acoustic properties. Before your work it was impossible hear witnesses a few feet away, but now, an ordinary tone of voice may be distinctly heard in any part of the room.

Very truly yours,

A. A. Bock

Clerk Circuit Court.

Let us now consider smaller rooms, used for various purposes. In the modern office building there are, as we have said, hard, resonating materials, the so-called patent plaster, metal lath, tile or marble floors and steel frame. There are many hollow spaces in the walls and a room in such a building is very apt to have what is commonly termed a whisper or hollow sound. The whole room may be set in vibration by a step on the floor or the moving of an article of furniture, a note from a musical instrument or by the voice. A carpet in such a room is very beneficial, yet, as in public halls, carpet is not always desirable. Hangings are used, also, but these may not be suitable for the purpose in view.

Take, for instance, a public school building; here it is desirable to avoid all echo. Carpets and drapery must be excluded for sanitary reasons. The result is that most school rooms, although supposed to be quiet, are large, empty spaces where every little noise becomes audible.

Where such a room is covered with Fab-Ri-Ko-Na Burlap, the empty sound is entirely prevented. The walls are sanitary, as Fab-Ri-Ko-Na Burlaps are sized with antiseptic materials and can be wiped off with a damp cloth at any time.

The room is cheerful and can be made very beautiful.

The new McKinley High School was finished about a year ago in the city of St. Louis. This is probably the finest building of its kind in the world. The authorities got it ready so that it might be an exhibit in itself during the World's Fair, showing the most approved form of school construction. In this building there were used some 22,000 yards of Fab-Ri-Ko-Na dyed tapestry burlaps. All of the walls and ceilings were covered with this material, and it has given the greatest satisfaction.

If it is desired to make the building fire proof, curtains or other hangings will be ruled out. Fab-Ri-Ko-Na Burlap, however, when pasted to a wall is practically fire resisting. It cannot be easily kindled even by holding a flaming torch against it.

The writer has gone to some trouble and expense to investigate this matter quite thoroughly. Peculiar facilities for such an investigation were afforded by the new building of the New England Conservatory of Music. The description of the acoustic properties of this building in the architectural journals, and the accounts of the experiments which were tried there, will be familiar to most of our professional readers. We shall, therefore, not stop to review them in this place. Suffice it to say that the old expedient of wires was tried; and a great many feltings of paper, asbestos, seaweed, and other materials were also tried. The results which were obtained, we believe, have all been published. We do not believe, however, that the results obtained by the use of Fab-Ri-Ko-Na Burlap in the smaller rooms of this building have been brought to the attention of the architectural profession. Those familiar with the plans of the building will remember that there are a great many small rooms which are used for studios by the various instructors in vocal and instrumental music. These rooms have given a great deal of trouble on account of an excessive resonance, and for a long time the instructors, as one of them expressed it to the writer, "Suffered untold agonies." This instructor demonstrated to the writer in a very striking manner what he meant. First we entered his studio. He struck a chord on his instrument, and then applied the soft pedal. The note was muffled immediately, and the sound was entirely under his control. Next we

went into an adjoining room of the same size and shape. The same chord was struck on a piano, and the soft pedal applied. The room continued to vibrate long after the string had been muffled, and the sound was not under the control of the musician. The difference was very marked. The walls of the studio of the instructor in question had been covered with Fab-Ri-Ko-Na Burlap by him, at his own personal expense. The walls of the room adjoining were hard white plaster, the same as his had been before.

The writer interviewed six or seven of the principal instructors in the Conservatory, both in instrumental and vocal music, who had had Burlaps placed on the walls of their studios, and each one, without exception, spoke most enthusiastically of the result, and a number of them kindly complied with the writer's request in writing a portion of what they had said.

The following are some of the letters from the gentlemen referred to:

THE NEW ENGLAND CONSERVATORY OF MUSIC

HUNTINGTON AVENUE

GEORGE W. CHADWICK
DIRECTOR

RALPH L. FLANDERS
MANAGER

BOSTON, MASS., April 14, 1904.

Messrs. H. B. Wiggins Sons Co.,
Bloomfield, New Jersey.

Gentlemen,

Your Mr. Cornelison visited me at the Conservatory the other day to see my Studio which is fitted with your burlap; he asked me if I would object to giving you an opinion upon the efficacy of the burlap in reducing the echo in my Studio.

I think I can state with perfect confidence that putting the burlap on the walls reduced the echo fully fifty per cent and this with the judicious distribution of rugs, and drapery has wholly eliminated what was a very bad and annoying echo. I should think this fact might be of interest to any persons who are troubled with echo in rooms or public buildings. It is much more efficacious than any wall paper could possibly be. It gives me much pleasure to acquaint you with these facts after the great relief I have experienced since fixing my room, I am,

Very truly yours,



Charles Gardiner
N. E. Conservatory

The writer interviewed Mr. Ralph L. Flanders, the Manager, and also Mr. Charles P. Gardiner, the President of the Conservatory. He also talked with some of the students. The verdict, without one

exception, was most favorable, being to the effect that the difficulties had been entirely removed by the use of the Burlap. Before leaving this subject, we should like to express our obligation to Mr. Henry P. Dreyer, one of the students in the New England Conservatory of



HUNTINGTON AVENUE.
 GEORGE W. CHADWICK. FRANK W. HALL.
 Director. Sec. and Manager.

BOSTON, MASS., April 18th 1904 1904

H. B. Wiggin's Sons Company,
 Bloomfield, New Jersey.

Dear Sirs:-

It gives me pleasure to state that the burlap put on the walls of my studio by your house has been in every way satisfactory.

The color is soft and agreeable to the eyes and it undoubtedly softens the tonal effects.

Yours very respectfully,

New England Conservatory of Music,
 BOSTON, Mass.

THE NEW ENGLAND CONSERVATORY OF MUSIC
 HUNTINGTON AVENUE

GEORGE W. CHADWICK
 DIRECTOR

RALPH L. FLANDERS
 MANAGER

BOSTON, Mass., June 1st, 1904

Mess. H. B. Wiggin's Sons Co.,
 Bloomfield,
 New Jersey.

Gentlemen:-

I have had the walls of my studio in the New England Conservatory of Music covered with your burlap for the purpose of overcoming the objectionable echo, which has caused considerable annoyance.

I am glad to say that this purpose has been very largely accomplished, and the experiment has proven a success.

Very respectfully yours,

Music, through whose courtesy we were enabled to meet the gentlemen we have just mentioned, and we would say further that it was through Mr. Dreyer's ingenuity that the Burlaps were first tried. He suggested them to one of the instructors, and many of the others followed the example. We have no doubt that the gentlemen who have written us the letters printed above would be willing to answer any questions upon the subject which any of our readers might desire to ask.

So successful were these experiments at the New England Conservatory that we concluded that it would be worth while to bring the matter to the attention of the architects of the country. In out-

*N. E. Conservatory of Music
Boston, Mass
May 16th 1914*

Mr H. B. Higgins & Sons Co.

Dear Sirs -

*In regard to
your burlap which was used
to cover my room here, all
say that the result is very
satisfactory. The echo, which
was a bad one by the
way, has entirely disappeared
and the room is not unpleasant*

*Yours sincerely
Armand Tatin*

